

Mapping Horticultural Crops in Dabwali, Rania and Ellenabad Blocks of Sirsa District, Haryana, India

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Abstract-Haryana state has a rich diversity of horticultural crops due to the presence of diverse agro-climatic zones ranging from sub-tropical and semi-arid to sub-humid. The present paper describes the methodology and results of block level acreage estimation of horticultural crops using high resolution and medium resolution satellite data. Different analysis approaches such as onscreen visual interpretation using high resolution World View-II data and hybrid classification approach using medium resolution IRS LISS-III data were explored. The total horticultural fruit crops area in the study blocks obtained by onscreen visual interpretation approach and hybrid approach is found to be 3236.34 hectares and 2848.37 hectares respectively. The horticultural fruit crops area obtained by onscreen visual interpretation approach are categorized into young and mature horticultural crops also. The remote sensing based area estimates of horticultural fruit crops were compared with Dept. of Horticulture (DOH), Haryana estimates by computing per cent Relative Deviation (%RD). Remote sensing based area derived using onscreen visual interpretation of high resolution World View-II data was found to be quite close to DOH estimates with RD ranging between -1.1 per cent for Ellenabad block to -9.4 per cent for Dabwali block. Large differences were observed in remote sensing based area estimates derived applying hybrid classification approach using medium resolution IRS LISS-III data and relative deviation varied between -17.7 per cent for Dabwali block to -23.4 per cent for Ellenabad block as compared to DOH estimates.

Keywords: Remote Sensing, Horticultural Crops, Hybrid Approach, Accuracy Assessment.

I. INTRODUCTION

Horticulture is science and art of gardening and of cultivating fruits, vegetables, flowers, and ornamental plants. Horticulture generally refers to the agriculture of growing of fruit crops, usually on a large scale. A horticultural variety of a plant is the one produced under cultivation, as distinguished from the botanical species or varieties, which occur in nature. The area under horticulture crops in Haryana has reached about 6.34 percent of the cropped area in the state as a result of the steps taken by the government to motivate farmers to grow horticulture crops in place of traditional ones. Apart from this, farmers also took keen interest in replacing their traditional crops with other commercial horticulture

crops like fruits, flowers and spices. During the current financial year up to 2011-12, fruit production of over 3.19 lakhs tones was achieved by bringing 3745 hectares of additional area under fruit cultivation and as a result the total area had increased to 45,910 hectares.

II. OBJECTIVES

1. Mapping of Horticultural Crops using digital satellite data.
2. Comparison of estimates using high resolution and coarse resolution satellite data.
3. To explore applications of different 8 band satellite data combinations for identification and mapping of Horticultural crops.

III. STUDY AREA

Sirsa district came into existence on 1 September, 1975. The location of the district is 29°14' to 29°59' north latitude and 74°27' to 75°18' east longitude. It is surrounded by Muktsar, Bathinda & Mansa districts of Punjab in the north, Ganga Nagar & Hanumangarh districts of Rajasthan in West and South, Fatehabad and Hisar districts of Haryana in north east and southeast respectively. Geographical area of the district is 4,277 sq. km. which is 10.3% of total geographical area of the state. The climate of the district is arid which is characterized by its dryness, high temperature and scanty rainfall. The average annual rainfall in the district is 318 mm. The district is under control of Hisar division and administratively divided into seven development blocks namely Sirsa, Dabwali, Odhan, Baragudha, Nathusari Choupta, Rania & Ellenabad. Three blocks namely Dabwali, Rania and Ellenabad were selected for the present study. The Ghaggar, an important seasonal river in the district is a major drainage of the area.

IV. MATERIALS & METHODOLOGY

Remote sensing data is the basic data used for Horticultural crops mapping of the study area. World View-2 & Indian Remote Sensing satellite (IRS-P6) LISS-III data were used for the present study applying onscreen visual interpretation and digital analysis techniques respectively. Multi-spectral World view-2 sensor provides 1.8 meter spatial resolution data in 8 spectral bands while multi-spectral LISS-III provides 23.5 meter spatial resolution data in 4 spectral bands with 24 days revisit capability. Administrative boundary (district & blocks), statistics at district & blocks

level of Dept. of Horticulture and Forest Department and in season collected ground truth data in the form of GPS location was also used.

4.1 Methodology for On Screen Visual Interpretation Approach

The digital data was imported from the computer DISCS (CDs) on windows platform. Data was displayed to check the area covered and quality of the data. Then the digital data was registered with geo-referenced master images using image registrations procedure. After the geo-referencing of the data our next step was the mosaicing of scenes in which the study area is laying. Image of Dabwali, Rania and Ellenabad Blocks were extracted out from the mosaiced scene. Extracted images were displayed and Horticultural crops and plantations visually delineated based on the elements of visual interpretation using field knowledge and ground truth data available in the form of GPS locations collected using hand held GPS. To improve the accuracy of interpretation various enhancements and band combination were used to highlight the area of interest. Shape files have been superimposed on image to digitize the Horticultural crops. After the digitization of the horticulture area, horticulture crops are categorized into young and mature horticultural crops. After that the area was computed with the help of field calculator tools available in Arc GIS software. After statistics generation and accuracy assessment horticultural crops maps were generated with the help of Arc-GIS software.

4.2 Methodology for digital analysis using Hybrid Approach

Methodology describes the procedures that are adopted during the project work. Standard methodologies already developed by HARSAC and Department of Space, Govt. of India were used for different activities enumerated in objective of the project work. Digital image analysis was carried out at HARSAC, Hisar using ERDAS 11.0, GEOMATICA 10.3 and ARCMAP 9.3 software packages. The geo-referenced images were used for digital analysis using complete enumeration approach. In complete enumeration approach the administrative boundary of the districts was overlaid on the images, a mask generated and superimposed on the geo-referenced image. All the data elements (pixels) within this were extracted for further classification etc. Unsupervised classification approach Iterative Self-organizing Data Analysis Technique (ISODATA) Clustering classifier was used. The horticulture mapping was done using classified images and logical combination applying hybrid approach. After that horticultural crop maps were generated.

V. RESULTS & DISCUSSIONS

5.1 Horticultural Crops Mapping Using Onscreen Visual Interpretation Approach

Geo-referenced World View-2 multispectral data was mosaiced and three blocks to be studied were extracted after overlying administrative boundaries. Digital data was displayed and Horticultural crops area was delineated. Different band combinations and enhancements techniques

were used to identify Horticultural crops. Citrus is the major crop of the study area followed by Guava (*Psidiumguajava*), Ber (*Ziziphusmauritiana*) and Grapes (*Vitisvinifera*). As the area of Guava Ber and Grapes is insignificant and spectral signatures are similar to Citrus hence cannot be separated. The total Horticultural crops area in the three study blocks is 3236.34 ha. Concentration of Horticultural crops area is more in Dabwali block having 2439.15 ha area is significantly higher as compared to Rania (404.67 ha) and Ellenabad (392.53 ha).The total horticultural fruit crops area obtained by onscreen visual interpretation approach is categorized into young and mature horticultural crops also. Category wise area is given in Table 2.Spatial distribution of category wise area is depicted in Map 1.

Remote Sensing (RS) based Horticultural crops area at block level compared with the area provided by Dept. of Horticulture (DOH) for the same year i.e. 2011. Remote sensing based area was found to be quite close with DOH estimates (Table 1).

Table 1: Horticultural crops Area in Different Study Blocks

Block	Area in ha (RS)	Area in ha (DOH)	%RD
Dabwali	2439.15	2693	-9.4
Rania	404.67	415	-2.5
Ellenabad	392.53	397	-1.1
Total	3236.34	3505	-7.7

RS-Remote Sensing, DOH-Department of Horticulture, RD-Relative Deviation

Table 2: Area under Different Categories of Horticultural crops in the Study Area

Type of Horticultural crops	Area in ha (RS)	% of total horticultural crops
Young Horticultural crops	1499.76	47
Mature Horticultural crops	1736.58	53
Total Area	3236.34	100

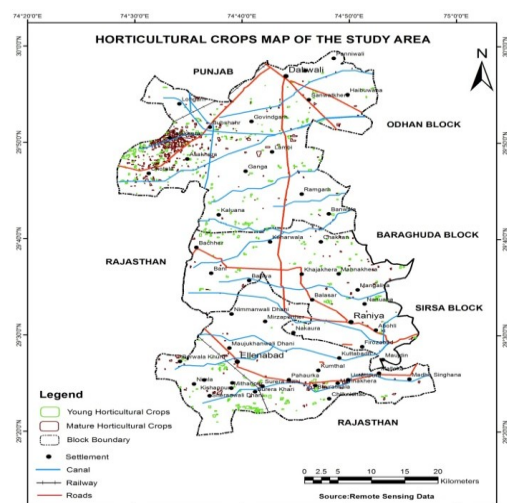


Fig. 1: Horticultural crops map of the study area

5.2 Horticultural Crops Area Mapping Using Hybrid Approach

IRS-P6 LISS-3 multispectral data of October 15, 2011 was used for the mapping of Horticultural crops using Hybrid approach. Hybrid approach consists digital classification for delineation of Horticultural crops and onscreen visual interpretation of the areas for which the classes are not properly delineated. The total Horticultural crops area for the three study blocks derived using the hybrid approach is 2848.37 ha, out of which 2214.89, 329.61 and 303.87 ha area is recorded in Dabwali, Rania and Ellenabad blocks respectively (Table 2). Spatial distribution of Horticultural crops is depicted in Map 2. RS based estimates of Horticultural crops were compared with Dept. of Horticulture (DOH) estimates by computing percent relative deviation. There are large gaps were observed in the area derived using hybrid classification approach (Table 3).

Table 3: Horticultural crops Area in Different Blocks of Sirsa District using hybrid approach

Block	Area in ha (Hybrid Approach)	Area in ha(DOH)	%RD
Dabwali	2214.89	2693	-17.7
Rania	329.61	415	-20.6
Ellenabad	303.87	397	-23.4
Total	2848.37	3505	-18.7

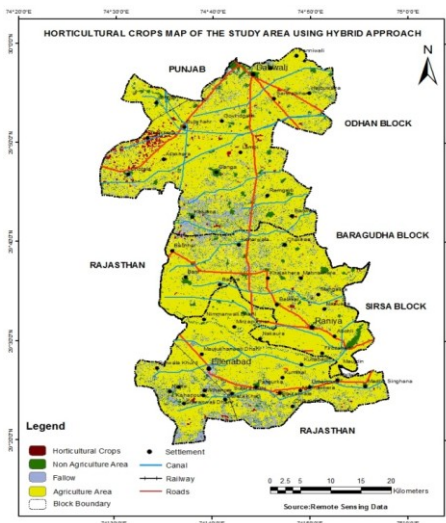


Fig. 2: Horticultural crops map of study area using hybrid approach

VI. CONCLUSIONS

- The total Horticultural crops area observed in the study blocks is 3236.34 ha using World View-II data and onscreen visual interpretation approach and 2848.37ha using LISS-III data and Hybrid digital classification approach.
- Total Horticultural crops area was also categorized into two categories i.e. young and mature/old Horticultural crops. In the entire area, 53% area is observed under mature Horticultural crops and 47% under young Horticultural crops.

- World View-2 digital data was also used for digital classification of Horticultural crops mapping using unsupervised classification approach but the accuracy of the result was not up to mark and the area estimates were not presented in the paper
- High resolution multi-spectral World View-II data is found to be quite useful for the mapping of Horticultural crops (using onscreen visual interpretation approach) which is a non-contiguous minor crop.
- The World View-2 digital data used in the study was not acquired on a single date. Due to this temporal variability similar object having the different spectral response resulting in to misclassification during digital classification.
- Handling of the World View-II data is very difficult due to large volume.

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